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From Designed Cognition to Built Architecture

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***Abstract*—**We know that Architecture, knowledge and paradigms of the human cognition, are strong linked between them self during the history; and that this relationship has always allows important and fascinating results.

Since 30 years the design of Architecture is dramatically changed. The digital/virtual dimension is part of the normal way of thinking architecture design. But the real value of digital factor in architecture is really a very complex challenge.

Since several years, new research area are born in this field between "visualization factor" and architecture design.

***Keywords*—**Design Cognition, Architecture, Shape, Construction.

I. Introduction

Probably at today we have the opportunity to understand better a possible new theoretical approach about the means of "visualization" in architecture. But it is possible to try a new significant approach from an another point of view.

<How a real architectural design might represent the method that its contemporaries had of conceiving the architecture design?>

The architectural "look" talks us about the worlds of design that was on the backstage of the architecture during the centuries. The architectural "look" is a message: the world of architectural design background; a technical background, for sure, but a cultural one too.

II. The Architectural Shape Across the Centuries

Thinking, we at some icons of the Architecture during the Centuries… The architecture of the Pyramids is the message of a design knowledge based on the Trigonometry science.

In addition the architecture of Pyramids is the message not just for a design conception, but of a world conception: thinking i.e. how trigonometry was important in astronomy and navigation. The ancient architecture was physical related with the astronomy (it was not just a pure idealization) because the trigonometry was the way to conceive the relationship between stars, planet, comets, etc.

The architectural geometry of the Pyramids (figure 1) was the picture of a specific manner for humans to conceives the reality and the architecture design as part of this reality. The Pantheon (figure 1) is the picture of an architectural geometry that means masses geometry that means structural geometry. This build was based on the studies of geometry and not on the roman number, really unusable. What tell us the architectural "format" of Pantheon? The base principle of the ancient masters of Architecture: the control of geometry was the control of the principle of equilibrium, consequence of the disposition of the masses.

The architecture of Pantheon is a picture of the power of geometry. The geometry was the base of the constructive representation of this building[1]

Fig. 1 Icons of Architecture's geometries: Pyramids and Pantheon

During the Renaissance, (figure 2), the architectural design "look", is the announcement of the [2]perfect correspondence between design knowledge and built architecture.

We know why. That happens because the architectural geometry during the Renaissance has a only name: "the perspective".

The Architecture during the Renaissance was the Architecture of its "quid". This "quid", the Perspective, was in the same time, representation and construction.

Indeed, the scientific concept is precisely what finally makes space perceptibly "measurable" and leads us to consider an architecture made in its image and likeness: a modular, proportioned architecture, made up of repeatable elements made to be "perspectiveable".

What is the announcement of the architectural of Modern Movement? The industrial-look.

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[1] In addition, we know how the architectural geometry in the Pantheon is the environment where the heart meets the sky, through the light. The Pantheon is an architectural geometry opened

Some buildings shape of the International style are really the icons of the building as machine.

"Called by postmodern historiography of "inibition" towards form, this approach was profoundly motivated because it symbolised the way in which machines were conceived, designed and constructed". (A. Saggio, 2004).

The concept of the shape was studied and defined through the language of the axonometry, geometry was thought according to the factory would have produced that it and constructed.

Also, the end form was determined by meaningless abstract signs (pilotis, the two-dimensional plane, the glass slot), put together, like pieces of a mechanical object, based on rules of pure syntax. An aseptic geometry, like a standard assembly line. We know the effect, specially from some specific point of view: i.e. the "full/empty" relationship about the architectonical volume (figure 2).

Fig. 2 Brunelleschi: Cupola del Duomo, Firenze. Terragni: Casa del Fascio, Como.

III. New Architectonic Spaces

For centuries there has always been a strong link between concept of space and Architecture, and vice-versa. In addition, design has always had the meaning of being a "verified conception". This conception happens always in a space. Changing the meaning of space, means changing the meaning of design.

The computational dimension has become an important component of the architectural design process and has opened many possibilities not just for the representation of the design, but of the design itself.

The use of digital technologies in architecture is still object of animated discussions ranging from criticism of current digital practice, to philosophical investigations on the future of digital design.

But in spite of all the discussions, the digital/virtual dimension has significantly affected architectural design and visualization in many different ways.

The past few years have seen the birth of new research areas at the intersection of digital/virtual technologies and architecture design.

One of the possible way to summarize this complexity of research visions is thinking on two main trends: the Architecture of De-formation and the Architecture of In-formation.

The "Architecture of De-formation", could be a new standard for the built architecture; the "Architecture of In-formation" could be a new standard for the designed architecture.

'Virtual Archtecture of De-formation' deals with form and function and the extraordinary possibilities of manipulation, deformation and interaction offered by computer technologies .

"Virtual Architecture of In-formation" deals with new visualization and communication paradigms based on the use of digital techniques.

Information is the greatest commodity of this age. In other words, information is the key to this age and – please note - electronics are its main tool. Today's architects and engineers are faced with the challenging problem of understanding, managing, representing and communicating large amounts of data that increase the complexity of the architectural design.

Architectural design interest different scale, included the urban simulation.

Some innovative digital resources, i.e. software of traffic simulator - UC-win /Frame, UC-1 by Forum 8, Tokyo - can include the digital architectural representation in a sort of animated and dynamic world, where we can really have the same urban environment, not just from a technical point of view (number of cars, speed, interaction with pedestrian, …) but, where it is possible to feel the architecture from a moving point of view (i.e. the normal way of driving).

IV. Real Construction "From" no Real Space

Today we have these new resources: digital and virtual, that allow us to understand and to improve our creative action on reality. To design means to change reality and/or offer new ideas about reality; this action happens in a "space". For designers space is not only a physical entity, but also a mental concept.

This new "space", in fact, is the virtual environment itself, but it is also a new cognitive space (i.e. the virtual dimension improves the ability of designers to conceive the physical space, and to discover new regions of our mental space).

In addition, the virtual dimension (i.e. the new opportunity to simulate real conditions) is a new resource in managing the architecture design process itself. Designers always strive to reach a perfect match between the design of the building and its physical construction.

In our times, architectural design has become so complex that traditional ways of managing the design process are no longer sufficient. New research fields (i.e., data perceptualization, scientific visualization, augmented reality,…) could be a new resource for this problem.

A new approach to architecture design, based on the ICT innovations, offers a new way to understand and to control the architectural design process in a synthetic and complete way.

The digital/virtual dimension has really introduced a new way of understanding and manipulating not only design data, but also the meaning of the design itself.

It has become apparent that the new generation of architects is searching new territory. The conquest of a new cognitive space leads to the conception of a new architectural space, typical of a so-called "digital" – or "transgenic", "blobby", "liquid" architecture.

Many of the programs recently appropriated for use by architects have allowed this generation to work with remarkably complex curvatures and non-Euclidean shapes that would have been inconceivable without the use of the computer and sophisticated animation software.

There are different cultural positions about this new architecture, but what it is important for a critical point of view, it isn't the aesthetic quality, but the concept of design.

If we observe some examples of this architecture we note that the electronic model it is not just a tool for studying, testing, simulating and constructing. The design concept can born from the nature of the digital resource.

Fig. 3 Nuragic and contemporary art museum, Hadid, Cagliari, Italy

The design of the architecture, is the design of the digital matrix. Changing matrix, means changing the concept of space and vice-versa. Changing the architectural geometry means changing the concept of time.

What the new current geometries are changing in architecture are "the times" of the architecture itself…The current architectural geometry is in the space but across the time.. the architectural geometry has *inside* a sort of *narrative time*. The architectural design dimension is moving from 3D to 4D. In addition, it is a "new-old" message in the actual architectural geometry.

Since the Renaissance, it is the first time that the architectural geometry *is constructed exactly just as it is designed.* Architectural space from virtual environment is the announcement of a new material for the architecture itself. A new geometrical knowledge for architecture allows a new architectonical material: the digital information itself. The architectural digital factor mediated, is *narration in becoming.* A new factor "of narration" is changing the concept of the Architecture itself.

Part of the current architecture is an architecture characteristic of the new digital dimension of the Information Age. An architecture not only narrative and metaphorical, but effectively interactive

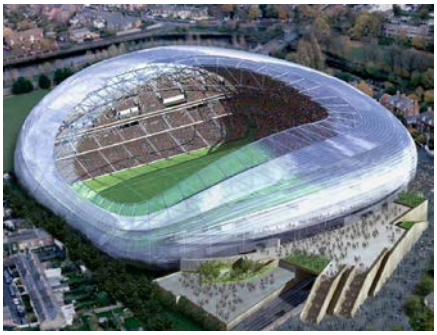

Fig. 4 HOK and Buro Happold Lansdowne Road Stadium, Dublin

V. New architectural Design Cognition ?

In the past, a conception of the architectural design, was implicitly verified as one designed and built according to professional standards, that had been developed over the centuries. This verification was empirical (Gucci N. 1999).

Nowadays, the designing conception is verified (in "a priori" manner), before the building is erected. How it is possible?

Through the modeling of its structural features, through an interactive process running across different disciplines and iterative between the time of the ideational expression and the time of its verification, based on a wide-ranging concept of digital modeling, (not just as pure geometrical modeling). Also, the architectural design process, happens today in a digital dimension too.

Nowadays, if we think about the environment of the design process, we understand that the digital representation of the concept "is" the architectural design "content".

In the virtual space new design approach are born no possible before. We could affirm that the digital elaboration, is today the only way to obtain built architecture.The digital visualization is changing. The gap between virtual and real architecture is reducing.Why? Because we have more powerful digital devices? Because the realistic approach can win using the most sophisticate rendering resources? Not only for these reasons!

The concept of the "make architecture" is changing … today, visualizing the concepts of the architectural "fabrica", step by step, becomes more and more necessary.

Thinking at the several approach about the new field of the "formalization of architectural knowledge": we could understand these approaches under the "collaborative design" umbrella.Why we need a collaborative design approach?

Simple, we know that <the design of a complex building system consists of a purpose-oriented collective process that is defined in time, split up into phases, implemented directly or indirectly by numerous professional profiles (all denoted as "actors" (Wix 1997), and characterized by the co-presence of numerous disciplines and specialist skills which is part of a broader process aimed at the construction, maintenance, and ultimately the demolition or recovery of the building as its product (Carrara and Fioravanti 2001)>.

Also, what is the real meaning of some new design problems: i.e., the problem to find a knowledge based environment able to support the complex architectural design, or the problem to management the knowledge itself, or the problem to communicate the concept like a *common* or s*pecialist* knowledge?

The real meaning is (the problem) to built the "Architecturae Fabrica". From a sort of holistic point of view the digital environment is the first environment of the architectural Idea. Please note, that <inside> the virtual space, the architectural idea can have important attributes, like space and material.

The concepts of Space and Material are inside the concept of Architecture. Space and Material (as concept) are the same in the virtual and in the real world too.

What changes is "only" the nature of this concept. Also, the concept of Architecture can born everywhere, inside the virtual world too.

The computational design is not just a clone of the real architecture, because could happen *before*. From this ontological point of view, we can affirm that the AEC, IFC, BIM resources, are the "symbol" of this concept.

In the Building Information Modeling approach, i.e., the potential of the digital space brings a really new about a change in the method: the use of computational modeling during design, and not afterwards. Different information sources are arranged to generate a new source of information, that comes from the virtual space.

It is possible to use in the virtual world the same object that we have in the real: what reduces the logical gap between the two worlds of architecture? The possibility to built in the virtual environment buildings according to what happens in the reality (i.e., about the architectural details or the constructive schedule).

On an epistemologic base, the more important phenomena, is that the virtual representation covers the field of the conceptual entities. These entities could be material - i.e. the technical components - but immaterial too: like the ontologies of the architectural design.

The ontology can have virtual representation and real substance in the same time.

Also, we are understanding that the substance of the architectural fact don't change, while we are moving our self between virtual and real world.

The architectural fact is just related of his knowledge structure or substance. To sum up, we know that the architectural fact happens "before" its materialization: where? In the human being, in the human idea or vision or understanding. This "first step" comes out from the human factor and, "after" can go to the virtual space, or to the real environment or to the new mixed space, or to the possible space of the future. The distances between virtual and real architecture is really small, if it is understood from a point of view, located in the architectural <Substance>[3].

The meaning of the human idea, remains even if the architect develops his idea using a computer mediated process. In this case we can observe that the human "imprinting" is to shift the idea from the project to the process.

But the human factor decides always the nature of the architectural fact that he wants obtain. At less, evaluating the results at the end of the computer mediated process.

Also we can affirm that only in the human being the architecture becomes conscience.

VI. Conclusion

We could affirm that it is knowledge itself that is "represented" in the architectural representation, and – in addition - that design technology affects the cognition of the Communication of the Architecture in several ways.

The architectural "look"/representation is a message: this message affirms how and how much a real object could "resemble" the method that its contemporaries had of representing it.

Basically, from an aesthetic point of view, the contemporary architecture cannot "not be from digital visualization".

Architecture should be "from digital", because, probably, digital is the actual theoretical phase of the Architecture.

Renaissance Architecture (influenced by the "new science" of Perspective) has been transformed to be "perspectivable" itself (object/subject of perspective). The Architecture of "Funzionalismo" (Modern Movement), has been transformed to be "industriable" (o/s of industry): objective, separated, mechanical, not just standard-built (the assonometric representation was its announcement).

Today (part of) Architecture born to be "digitable" (o/s of digital): to include the dynamic, the connection, the interactivity of the digital paradigm.

The main focus it is not only considering "also" the tool, to understanding how certain senses of space were born, but the focus is overcoming this point towards another concept: the architectural space is "the place" of interactivity, of interaction, of dynamic, between the genius of the designer and the cultural and technological background of an architectural age.

Probably, the virtual dimension will be a important part of the 'mental landscape' of the current and future's architectural design.

[3] (We know, i.e., the distance between Jupiter and the Sun is longer with respect to the distance between the Heart and the Sun, but by a observer who could be located on Alpha Centaury, the two distances before are the same).

The “Digital-Visualization” factor, if well considered, to take back the meaning of designing to its original value. This value goes in line and not against tradition. During the Centuries, one of the main focus for the architects, was to build an Architecture that could resemble even more to their ideas and conceptions. Digital dimension offers a new scenario to obtain this focus. Also, at today, we have a new research field: working to built the bridge *between the new digital dimension and the traditional human content.*

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